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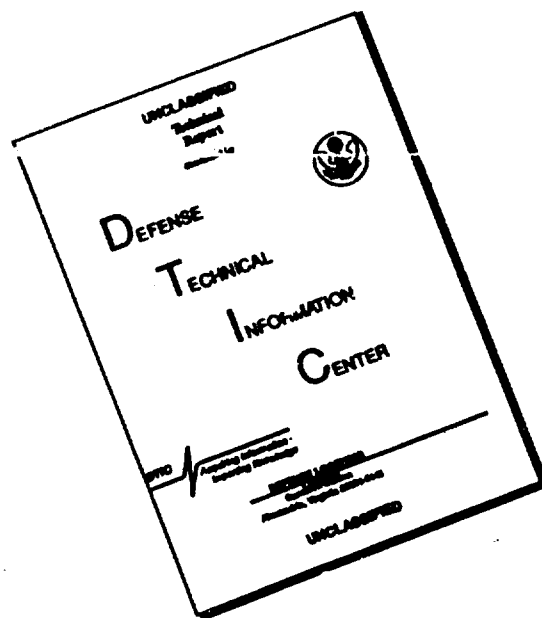
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**STUDIES ON FUMIGANT "ETHYLENE OXIDE" (V)**

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## STUDIES ON FUMIGANT "ETHYLENE OXIDE" (V)

### Influence of Methyl Bromide on Baking Quality of Wheat Flour

Journal of the Hygienic Society  
Vol 5, No 2, April 1964, pp 144-146

Yoshiko KOYANAGI, Osamu TSURUTA,  
Teruo OHTA, and Toyoaki HARADA.  
Food Research Institute, Ministry  
of Agriculture and Forestry; 2.  
Hamazono-cho, Fukagawa, Koto-ku,  
Tokyo

There was negligible lowering of the strength of  $\alpha$ -amylase activity throughout the experiment of fumigation, as recorded by chimotachigraph, amylograph and albeograph.

There was no degradation in the amount of gluten or in the  $\beta$ -amylase activity. By the above treatment, there was a slight degradation in the special flavour and taste of the baked products, but it was concluded that there was not too much disadvantage practically.

(Received January 27, 1964)

#### Introduction

Methyl bromide as a fumigant has been fully evaluated. However, the literature concerning the research<sup>1-3</sup> on use of ethylene oxide indicates that publications on use of flour fumigated with methyl bromide concerning its suitability as a bread material are seldom found. Since the purpose of adding methyl bromide to ethylene oxide became clear in paper No 4, from the standpoint of fungicidal property and explosion limit, the fumigated flour as a bread material is investigated using a reagent slightly in excess of practical amount. The results are reported in this paper.

#### Experimental Method

The fumigation of the flour (brand: Ocean) was conducted by the same method as in the previous report so that a comparison can be made with ethylene oxide. The flour in a commercial graft paper bag (20 Kg content) and unpolished rice (30 Kg content) are placed in a fumigation container of 1.5 m<sup>3</sup> and left at 20-30° for one full day. After the temperature equilibration, these are fumigated for 24 hours with 200 g of methyl bromide. The practical test on the bread material is made at 30° by taking a fixed amount right after fumigation and evaporating the

remaining gas for 30 minutes. Also, in order to examine the property changes with time, the bags of fumigated flour are left in the room for 7 and 20 days. The test materials are taken out from these and examined. The investigation on the change in the property of flour by chimotachigraph, amylograph and albeograph or the measurements of gluten and  $\beta$ -amylase are conducted 30 days after fumigation.

#### Experimental Results and Observations.

##### 1. Test of material expansion.

The unfumigated and fumigated wheat flour are respectively made into bread material by mixing the following proportion of raw materials. For 100 of wheat flour, yeast is 2, salt 1.7, sugar 4, shortening 3 and water 64.5. These are placed in cylinders at 30°, and the degree of expansion is measured at every ten minutes. The results are shown in Figure 1.

When the wheat flour is used as bread raw material right after fumigation, the expansion of bread material is inferior perhaps due to the effect of fumigant. However, in a few days this phenomenon disappears. This tendency is also pointed out by Kakuta et al<sup>5</sup>.

##### 2. Test of bread.

We already know that the wheat flour as a raw material has an effect on the material expansion during the initial period after fumigation. Here, we have investigated on the types of an effect when these are made into bread. The baking process is as follows. The bread materials are made from the same proportions of raw materials as in the previous section and at 30° the first fermentation is done for 90 minutes and the second fermentation for 45 minutes. These are transferred and placed for 15 minutes at 25°. Then, after placing these in the oven at 37° and 90% humidity for 55 minutes, they are baked for 20 minutes at 213.5°.

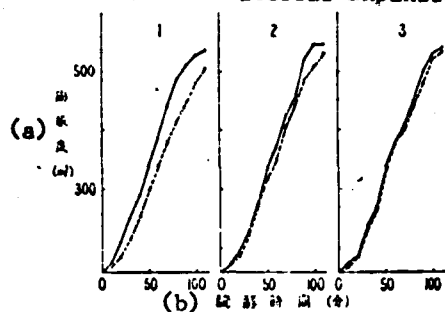
The results on the examinations of weight, volume and function of the bread made by the above process are shown in Table 1. The volume of the bread made from the wheat flour with low degree of expansion right after fumigation was not low. Since this is related to gluten, the amount of gluten was measured as in the following section but the difference between these two is not observed. Thus, this phenomenon is considered to be due to a small reduction of amylase in the wheat flour during the fumigation.

From the standpoint of volume of the bread thus manufactured, use of the fumigated flour is practically considered to be not objectionable. However, the loss of the characteristic bread flavor and taste, however

slight it may be, can not be overlooked.

Figure 1

Results of Raw Material Expansion



1. クン蒸終了直後のもの  
2. クン蒸終了7日経過のもの  
3. クン蒸終了後20日経過のもの

(c) o----o 無クン蒸小麦粉 (d) x----s クン小麦粉

- LEGEND: (a) Degree of expansion (ml)  
(b) Fermentation time (minutes)  
(c) o----o Unfumigated wheat flour  
(d) x----s Fumigated wheat flour  
1. Immediately following fumigation  
2. 7 days after fumigation  
3. 20 days after fumigation

Table 1

Results From the Inspection of Bread Quality

Column a		(1) クン蒸終了直後				(2) クン蒸終了後7日経過				(3) クン蒸終了後20日経過			
		(a)		(b)		(a)		(b)		(a)		(b)	
		無クン蒸小麦粉	クン蒸小麦粉	無クン蒸小麦粉	クン蒸小麦粉	無クン蒸小麦粉	クン蒸小麦粉	無クン蒸小麦粉	クン蒸小麦粉	無クン蒸小麦粉	クン蒸小麦粉	無クン蒸小麦粉	クン蒸小麦粉
重量	(g)	138	143	142	142	143	144	146	146	146	146	145	145
容積	(ml)	700	705	695	690	695	695	730	725	690	695	725	730
体積		9.07		9.07		9.07		9.07		9.07		9.07	
外皮	色	7.00		6.80		7.00		7.00		7.00		7.00	
形状	均整	4.37		4.37		4.37		4.37		4.37		4.37	
焼色	均整	2.60		2.60		2.60		2.60		2.60		2.60	
外皮質		3.50		3.50		3.50		3.50		3.50		3.50	
すだち		13.13		12.70		13.13		13.13		13.13		13.13	
内部色		8.75		8.75		8.75		8.75		8.75		8.75	
香味		8.75		8.75		8.75		8.60		8.75		8.70	
味		17.52		17.52		17.52		17.40		17.52		17.40	
触感		13.13		13.13		13.13		13.13		13.13		13.13	
合計		87.82		87.19		87.82		87.55		87.82		87.65	

- LEGEND: 1. Immediately after fumigation a. Unfumigated wheat flour  
b. Fumigated wheat flour

2. 7 days after fumigation    a. Unfumigated wheat flour  
   b. Fumigated wheat flour
3. 20 days after fumigation   a. Unfumigated wheat flour  
   b. Fumigated wheat flour

Column a

Weight (g)  
Volume (ml)

---

Volume  
Skin color  
Uniformity  
Baking uniformity  
Skin quality  
Starch  
Inside color  
Flavor  
Taste  
Tactile sense

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Total

3. The property changes of fumigated wheat flour.

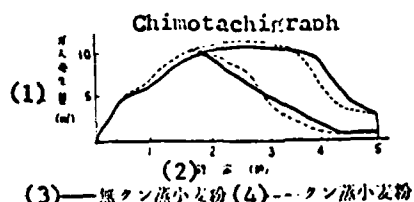
When the effects of fumigant on the wheat flour in bread raw Material are not small, there are cases where the practical bread tests can not detect these effects. Therefore, a few items related to bread are investigated here.

1) Investigation by chimotachigraph

The test material is made by mixing 3 g of salt, 4 g of yeast and 127.9 ml of water in 200 g of wheat flour. Employing chimotachigraph, the amount of carbon dioxide formed in the raw material and its change with time or the amount of carbon dioxide maintained in the raw material are measured. Figure 2 shows the results.



Figure 2



LEGEND: 1. Amount of gas (ml)  
2. Time (minutes)  
3. ——— Unfumigated wheat flour  
4. - - - - Fumigated wheat flour

As is obvious from Table 2 obtained from these results, the total amount of carbon dioxide formed in the raw material of the amount of carbon dioxide maintained in the raw material are not different in fumigated of unfumigated wheat flour.

Table 2

A Comparison of the Amount of Gas by Chimotachigraph

	(1) 全炭酸ガス (ml)	(2) 保持炭酸ガス (ml)
(3) 無タン蒸小麦粉	2367.58	1469.06
(4) タン蒸小麦粉	2323.34	1499.57

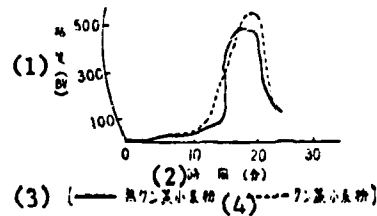
LEGEND: 1. Total carbon dioxide (ml)  
2. Maintained carbon dioxide (ml)  
3. Unfumigated wheat flour  
4. Fumigated wheat flour

## 2) Investigation by amylograph

Using the same raw material as in previous section, the behavior of the raw material in the oven is examined and Figure 3 is obtained.

Figure 3

Amylograph



- LEGEND: 1. Viscosity (BV)  
 2. Time (minutes)  
 3. ——— Unfumigated wheat flour  
 4. - - - - Fumigated wheat flour

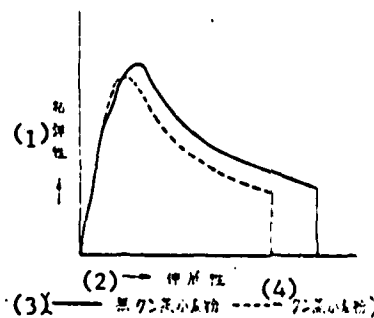
The difference in the starch conversion temperature is not observed but the temperature of the maximum viscosity is high for the fumigated wheat flour and low for  $\alpha$ -amylase.

3) Investigation by albeograph

The viscosity and elongation of the raw material are measured by albeograph and Figure 4 is obtained.

Figure 4

Albeograph



- LEGEND: 1. Elasticity  
 2. Elongation  
 3. ——— Unfumigated flour  
 4. - - - - Fumigated flour

As can be seen from these results, a small difference in elongation is not significant to affect the bread.

- 4) The effect of fumigant on gluten and  $\beta$ -amylase of the wheat flour.

Since gluten in the wheat flour seemed to be slightly affected by fumigation and the bread test could not detect these changes, they are measured by a simple quantitative analysis. The measurement indicates the fumigated wheat flour 41.5 against the unfumigated flour 42.0. Thus, no difference is observed. Also, the effect on the bread is considered to be not large. The results on the measurement of  $\beta$ -amylase by a common method show the maltose value of 228.0 mg for the unfumigated and 210.0 mg for the fumigated. Thus, no difference exists between these two.

#### Summary.

Employing the methyl bromide fumigated wheat flour, the suitability as a bread raw material is investigated and the following informations are obtained.

1. Investigation by chimotachigraph or the measurements of gluten and  $\beta$ -amylase do not show the changes in the properties.
2. A small reduction in  $\alpha$ -amylase is observed by amylograph and a small drop in the elongation is observed by albeograph.
3. The tendency of increasing the volume, except the case of immediately following the fumigation, is a superior property for the final bread test. However, when the bread is made from the fumigated wheat flour, a slight loss in the sense of the characteristic flavor and taste is noticed. This phenomenon does not cause any problem in using the reagent standard but should be kept in mind.

The authors wish to thank the members of the grain process research laboratory for their cooperation in the experiment of amylograph and albeograph. Also thanks are due to Dr. Sato, manager of nutrition department for encouragement and to Sanko Chemical Co for supplying the fumigant.

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